APPARATUS AND METHOD FOR LESSENING THE ACCUMULATION OF HIGH BOILING FRACTION FROM FUEL IN INTAKE VALVES OF COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

[001] The present disclosure relates generally to an apparatus and method for lessening the accumulation of high boiling fraction from fuel in combustion engines, and particularly to an intake valve arrangement for lessening the accumulation of high boiling fraction at the intake valve.

[002] A gasoline-fueled spark-ignition combustion engine traditionally has the fuel introduced into the intake system either through a carburetor or a port fuel injector. Some fuels contain high boiling materials, or fractions, such as polymer fuel additives or gum, and some of the high boiling fractions have a high viscosity, which generally increases exponentially with a decrease in temperature. Consequently, after an engine cools down, an accumulation of high viscosity high boiling fraction on the intake valve surfaces may result. Accordingly, there is a need in the art for an intake system in a combustion engine that may lessen the accumulation of high boiling fraction on intake valve surfaces.

SUMMARY OF THE INVENTION

[003] In one embodiment, an intake valve for a combustion engine having an intake port is disclosed. The intake valve includes a valve guide having an end proximate the intake port, a valve shield extending from the end of the valve guide and into the intake port, and a valve stem arranged proximate the valve guide and valve shield. The valve guide and valve stem define a first clearance dimension therebetween, and the valve shield and valve stem define a second clearance dimension therebetween, wherein the second clearance dimension is equal to or greater than the first clearance dimension.

[004] In another embodiment, a valve shield for a combustion engine having an intake port, a valve guide having an end proximate the intake port, and a valve stem movable relative to the valve guide and having a defined displacement with respect thereto, is disclosed. The valve shield includes a first end proximate the end

of the valve guide, a second end at a defined distance from the first end, an outer surface disposed between the first and second ends and facing the intake port, and an inner surface disposed between the first and second ends and facing the valve stem. The defined distance is equal to or greater than the defined displacement.

[005] In a further embodiment, a method for lessening the accumulation of high boiling fraction between a valve stem and a valve guide of a combustion engine is disclosed. The combustion engine is operated by introducing an air-fuel mixture into an intake port and then into a combustion chamber where the mixture is ignited therein. During operation thereof, a portion of the valve stem that extends beyond the valve guide is shielded from direct exposure to the air-fuel mixture, thereby lessening the accumulation of high boiling fraction on the valve stem and between the valve stem and valve guide.

BRIEF DESCRIPTION OF THE DRAWINGS

[006] Referring to the exemplary drawings wherein like elements are numbered alike in the accompanying Figures:

[007] Figure 1 depicts an exemplary combustion system in accordance with an embodiment of the invention;

[008] Figure 2 depicts a longitudinal cross section view of an embodiment of the invention;

[009] Figure 3 depicts an alternative longitudinal cross section view of the embodiment of Figure 2; and

[0010] Figure 4 depicts an axial cross section view of an alternative embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] An embodiment of the invention provides an intake valve for a combustion engine, the intake valve being structured to reduce the accumulation of high boiling fraction (also referred to as residue or gum) between a valve stem and a valve guide. While an embodiment described herein depicts a linear piston and cylinder arrangement as an exemplary combustion system for the combustion engine,

it will be appreciated that the disclosed invention may also be applicable to other combustion systems, such as a rotary combustion system employed in a rotary combustion engine for example.

[0012] Figure 1 is an exemplary embodiment of a combustion system 100 for a combustion engine (not shown) having a cylinder 105 and a piston 110 defining a combustion chamber 107, an intake port 115, an exhaust port 120, a fuel supply 125, such as a fuel injector for example, an intake valve 200, and an exhaust valve 300. In an embodiment, intake valve 200 includes a valve stem 205, and a valve head 210 (also referred to as a valve tulip) that has a seating surface 212 that seats against an intake valve seat 117 at intake port 115 during the opening and closing action of intake valve 200. Surrounding valve stem 205 is a valve guide 230 that is dimensioned in close relationship with valve stem 205 for guiding the movement of valve stem 205 during the opening and closing action of intake valve 200, and a valve shield 225 extending from a bottom end 233 of valve guide 230 that is disposed proximate intake port 115, best seen by now referring to Figure 2.

[0013] Referring to Figure 2, which depicts a longitudinal cross section view of an embodiment of valve stem 205, valve guide 230, and valve shield 225, having exaggerated dimensions for clarity and discussion purposes, valve stem 205 has an outer diameter D1 and valve guide 230 has an inner diameter D2, defining therebetween a clearance dimension g1, herein also referred to as a first clearance dimension, which is sized for valve clearance. Valve shield 225 extends from a bottom end 233 of valve guide 230 a length L into intake port 115, thereby providing a shield for a portion of valve stem 205 exposed within intake port 115. The inner diameter D3 of valve shield 225 and the outer diameter D1 of valve stem 205 define a clearance dimension g2 therebetween, herein also referred to as a second clearance dimension. In an embodiment, clearance dimension g2 is equal to or greater than clearance dimension g1, with a preferred g2-to-g1 dimensional ratio being equal to or greater than about two-to-one, and a more preferred ratio being equal to or greater than about five-to-one. The outer and inner surfaces 221, 222 of valve shield 225 define a thickness t, which should be as thin as permissible for its intended function. In an embodiment, thickness t is equal to or greater than about 1/8 of thickness T of

valve guide 230 and equal to or less than about 1/4 of thickness T. In another embodiment, thickness t is about 1/5 of thickness T.

[0014] Referring now back to Figure 1, at the top of valve guide 230 is a valve seal 235 for controlling the flow of oil from an oil reservoir, generally depicted as 130 in the combustion engine, to clearance dimension g1 between valve stem 205 and valve guide 230, which assists in the control of oil consumption. The end 208 of valve stem 205 is arranged in mechanical communication with a valve cam (not shown) of the combustion engine for driving intake valve 200 to an open position. Intake valve 200 is driven to a closed position by the action of a valve spring 215.

[0015] Referring now to Figures 1 and 3, an exemplary operational cycle of combustion system 100 begins with intake valve 200 being closed (see Figure 3, solid line), that is, with seating surface 212 seated against valve seat 117, and fuel injector 125 providing a supply of fuel to intake port 115 where it is mixed with air. As depicted in the exemplary embodiment of Figure 1, the spray 135 of the fuel is directed toward valve stem 205, valve tulip 210, and valve shield 225. In response to intake valve 200 being opened via the valve cam, the air-fuel mixture is permitted to enter combustion chamber 107, whereafter valve spring 215 drives intake valve 200 to the closed position and timed combustion and exhaust take place. The displacement of valve stem 205 and valve head 210, relative to valve guide 230 and valve seat 117, from the closed position (solid line) to the open position (dashed line) is depicted as dimension d (see Figure 3). In an embodiment, length L of valve shield 225 is equal to or greater than dimension d, which effectively shields that portion of outer surface 207 of valve stem 205 that travels in and out of clearance dimension g1 between valve stem 205 and valve guide 230.

[0016] During the combustion cycle, outer surface 207 of valve stem 205 is at an elevated temperature, which results in the evaporation of the low boiling fraction of the fuel that comes in contact with it, and the adhesion to outer surface 207 of the high boiling fraction of the fuel. With a portion of valve stem 205 moving in and out of valve guide 230 a distance defined by dimension d over many combustion cycles, valve shield 225 serves to lessen the accumulation of high boiling fraction on that portion of valve stem 205 that moves in and out of valve guide 230. Also, in an

embodiment where clearance dimension g2 is greater than clearance dimension g1, outer surface 226 of valve shield 225 may be designed to operate at a lower temperature than outer surface 207 of valve stem 205, thereby reducing the amount of evaporation of low boiling fraction and accumulation of high boiling fraction on outer surfaces 207 and 226.

[0017] In an alternative embodiment, and referring now to Figure 4, an axial cross section view through valve stem 205 and an alternative valve shield 227 is depicted with valve shield 227 only partially surrounding valve stem 205. An outer surface 228 of valve shield 227 faces the direction of fuel spray 135 and an inner surface 229 faces valve stem 205, thereby shielding or shadowing valve stem 205 from direct exposure to fuel containing high boiling fraction while reducing the effect on the flow of the air-fuel mixture going to combustion chamber 107. While Figure 4 shows one exemplary arrangement for shadowing valve stem 205, it will be appreciated that valve shield 227 may be arranged to provide other degrees of shadowing as well. The outer and inner surfaces 228, 229 of valve shield 227, similar to the earlier discussion relating to valve shield 225 in Figures 1-3, define a thickness t, and in an embodiment, thickness t should be as thin as permissible for its intended function, as discussed previously.

[0018] In view of the foregoing, combustion system 100, employing an embodiment of the invention, lessens the accumulation of high boiling fraction from the combustible fuel either by shielding outer surface 207 of valve stem 205 from being directly exposed to the fuel from fuel supply 125, or by reducing the surface temperature at outer surface 207 relative to outer surface 226, thereby lessening the evaporation of low boiling fraction and the accumulation of high boiling fraction between valve stem 205 and valve guide 230.

[0019] While an embodiment of the invention has been described employing a fuel injection system for supplying fuel, it will be appreciated that the scope of the invention is not so limited, and that the invention may also apply to a carburetor fuel delivery system.

[0020] As disclosed, some embodiments of the invention may include some of the following advantages: reduced accumulation of high boiling fraction on intake

valve surfaces; reduced accumulation of high boiling fraction between the valve stem and valve guide; and, reduced accumulation of high boiling fraction with low impact on air-fuel flow.

[0021] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best or only mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.